Introduction

PC-based games are developing a sizable following as military training tools. All Services use commercial off-the-shelf (COTS) games as well as custom games and simulated missions developed with PC engines. However, the value of PC games as an advanced distributed learning (ADL) resource is still largely untapped because they are not designed for ADL environments; they also lack consistent military training concepts and provide minimum feedback to players about performance quality.

DOD's vision for the ADL initiative is to "provide access to the highest quality education and training, tailored to individual needs, delivered cost-effectively, anytime and anywhere." The vision for The Army Distance Learning Program is similar: "Improve and sustain readiness by delivering standardized individual, collective, and self-development training to soldiers and units anywhere anytime using multiple delivery means and technologies."

Distance learning, for the most part, implies courseware. To ensure a student has grasped the learning objectives presented by the courseware, some type of assessment tool must be used. Typically, these assessments are multiple-choice, true/false, matching, or short answer fill-in-the-blank tests. While these tests are appropriate for most academic courses, they miss the mark for assessing a student's ability to perform according to military principles and doctrine. COTS games provide, at best, "accidental learning," i.e., there is usually no attempt to ensure a game player is using correct principles: shooting bad guys scores points. Players can win in most first-person shooter games regardless of whether they apply military doctrine and principles.

To improve games for Army training applications, the U.S. Army Materiel Command's (AMC's) Research, Development and Engineering Command's (provisional) Simulation Technology Center is

INTEGRATING PC GAMES INTO ADVANCED DISTRIBUTED LEARNING ENVIRONMENTS

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using ADL technology for the integration of courseware with PC gaming technology. The AMC's Research, Development and Engineering Command (provisional) is currently working to produce a learning tool in which the student completes a section of courseware and is assessed via a game-based simulation. As PC gaming technology continues to evolve, distance learning students will reap the benefits of more immersive environments. These engaging environments may have the potential to increase the retention of the knowledge and skills gained through distance learning. Currently, an Army Science and Technology Objective led by AMC's Research, Development and Engineering Command (provisional), with the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) as a partner, is intended to reduce refresher training by 25 percent through "overlearning." Overlearning involves continued training after a student has demonstrated proficiency on a task. In this partnership, AMC's Research, Development and Engineering Command (provisional) develops the special gaming technologies and ARI assesses their success as distance learning tools to enhance soldier performance.

The integration of courseware/ PC games with an intelligent tutoring system (ITS) and a learning management system (LMS) results in a very robust environment that can build a profile of a student's weak and strong

points. In general terms, an ITS provides the expertise of an instructor to each distributed-learning student. An LMS monitors the overall distributed learning process, from student registration to class participation to end-of-course assessment. The student profile can be used for a variety of purposes such as:

• Developing future game-based training scenarios;
• Assisting onsite instructors in a "blended," or mixed delivery, learning environment to tailor an individual's course of instruction to improve weak areas; and
• Building a "virtual team member" that allows the student's behavior to be modeled in an online exercise even if the student is not available.

Illustrative Scenario

To illustrate these concepts, assume a freshly commissioned Army second lieutenant in the infantry branch is reporting to the Infantry Officers' Basic Course (IOBC) at Fort Benning, GA. As a prerequisite, the lieutenant must complete a distance learning course as an introduction to the principles taught at IOBC. As the lieutenant proceeds through the online course, one particular section causes problems: movement through urbanized terrain. According to Army Field Manual 90-10, *Military Operations*

On Urbanized Terrain (MOUT), there are six principles to consider:

- Using covered routes;
- Moving only after defensive fires have been suppressed or obscured;
- Moving at night or during other periods of reduced visibility;
- Selecting routes that will not mask friendly suppressive fires;
- Crossing open areas (streets, space between buildings) rapidly under the concealment of smoke and suppressive fires provided by over-watching forces; and
- Moving on rooftops that are not covered by enemy direct fires.

Using the game-based simulation, whose controls are very similar to most first-person shooter games, the lieutenant masters four of the principles. However, by consistently choosing routes that mask the team's suppressive fire, the lieutenant fails principle 4, and, by extension, principle 5, more often than not. An ITS, akin to an online coach, delivers occasional hints by a computer-controlled avatar—a senior noncommissioned officer (NCO). The NCO warns the lieutenant against choosing the wrong route. Subsequent scenarios in the online game will involve selecting good routes to enforce the weak principles and build the required knowledge and skills.

Additionally, as part of an optional graduation exercise, distance learning students may participate in an online, multiplayer scenario that uses the same game as the courseware's assessment tool. If an individual is unable to participate, the game can create a virtual team member using the existing profile it has developed. Over time, an extensive selection of student profiles can be built and used to create an entire virtual team for multiuser exercises.

Upon the lieutenant's arrival at Fort Benning, the battalion commander checks the learning management system to see how the lieutenant progressed through the Web-based course. The commander notices a weakness in the selection of routes through urbanized terrain. Reviewing the records of other incoming students, he notices that three other students did not fare well on that principle. The battalion commander puts the four lieutenants together in a "study group" with an instructor who will work on their weak areas.

The Command's Role

This scenario is an example of how AMC's Research, Development and Engineering Command (provisional) intends to leverage the power of learning management systems, intelligent tutoring systems, handheld computers, PC-based games, and engaging courseware to develop a Web-based training environment that is available anytime, anywhere, and tailorable to the individual student. In the scenario, the ITS picks up on areas in which the student is weak, provides hints, and even incorporates the weak points in subsequent scenarios to ensure the student continues to see those principles that he or she has not mastered. The game-based simulation passes assessment results back to the LMS, which builds a profile of the student. This profile is used to build a virtual computer-controlled character for multiplayer game purposes. However, it should be noted that this particular research does not suggest that Web-based simulation should replace live training. Instead, we are advocating that Web-based simulation should augment live training so students can "hit the ground running" to make their live training more effective and efficient.

Challenges

While the concepts presented in this article are all individually achievable, integrating a game engine, courseware, LMS, and ITS together into one cohesive environment is a considerable challenge, financially if not technically. COTS games, as a whole, are not an effective option for assessment tools as they tend to reward players solely for shooting an opposing player. Thus, integrators and content developers must develop the proper mix of tools to complement the COTS games. Also, while ITSs are not new, they are expensive and somewhat limited in scope. They typically consider only a limited number of correct solutions and will mentor students if they veer off the "textbook" solution.

Integrating learning management systems into the target environment appears to be the easiest of the tasks; LMSs should, in theory, be able to accept assessment results from a game as easily as they do from a traditional test. Finally, the issue of conformance with the Sharable Content Object Reference Model (SCORM), an ADL standard intended to aid instructional system developers in sharing educational content across different LMS platforms, poses a challenge. Although the "C" in SCORM has changed from "Courseware" to "Content," the SCORM community is only now taking into account such nontraditional content as game engines.

Conclusion

When PC-based games are integrated with learning management systems and intelligent tutoring systems, the Army will be able to provide a training environment with the correct application of doctrine and principles.

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